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(54) METHOD FOR MANUFACTURING FIBRE REINFORCED CEMENT ARTICLE

(71) We, KUBOTA, LTD., a Japanese Company, of 22, 2-chome, Funade-cho, Naniwa-ku, Osaka-shi, Japan 556, do hereby declare this invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a method of manufacturing fiber reinforced cement sheet which contains essentially glass fiber as its reinforcing fiber material; and particularly to manufacturing said cement sheet using a paper making method.

In the manufacture of cement sheet material, it is necessary to reinforce said sheet-material with fiber in order to improve the mechanical strength of the sheet produced. Hitherto there has been adopted mainly asbestos fiber for as such reinforcing fiber.

Asbestos reinforced cement sheets are conventionally manufactured by means of a paper making method. That is to say, first slurry is prepared by mixing and stirring asbestos film, cement and water using a pulper, and the resultant slurry is fed into a vat and made into a thin sheet by applying slurry to a mesh of a paper making cylinder. The resultant sheet on the mesh is transferred onto a felt belt or roll which rotates in contact with said cylinder, and the sheet so transferred is further tranferred and wound onto a paper making roll which rotates in contact with said felt belt or roll.

Thus when the thickness of the wound sheet reaches a predetermined level, the wound sheet is cut, peeled off and then converted into a flat sheet form. The flat sheet so formed is hardened by allowing it to stand or by autoclave treatment.

The asbestos employed for making asbestos reinforced cement sheet is classified into eight classes in accordance with a Canadian Industrial Standard.

It is necessary for the production of asbestos reinforced cement sheet having a bending strength of more than 300 Kg/cm², by use of a paper making method, to use high grade asbestos of classes 4 to 6 in an amount of more than 35% by weight based on the total raw material.

While the strength of asbestos is obviously less than that of the glass fiber which is used conventionally as a reinforcing fiber for making fiber reinforced plastics material, recently manufacturing and practical usage of glass fiber reinforced cement sheet has occurred because of the rising price of asbestos owing to the exhaustion of asbestos resources.

The manufacture of glass fiber reinforced cement sheet may be effected on the above-mentioned paper making equipment. In the manufacture of asbestos reinforced cement sheet have a bending strength of more than 300 Kg/cm² by use of a paper making method, it is necessary to use plenty of high grade asbestos (4—6 class). On the other hand with glass fiber reinforced cement sheet, the same bending strength can be obtained with less high grade asbestos.

We have studied the manufacture of glass fiber reinforced cement sheet by use of said paper making equipment. The glass fibers used in this study were 6—20 mm cut length consisting of 75—1800 monofilaments of 4.5—14.0 μm diameter.

In this study we found that conglomeration after tangling of the glass fiber was inevitable during the slurry preparation step which comprises mixing and stirring of the glass fiber chopped strand consisting of 600 glass monofilaments, with cement and water. Owing to the above-mentioned conglomeration, the glass fiber can not be uniformly disposed in the cement slurry and the glass fiber dispersion state in the sheet obtained from this slurry, with adoption of paper making method, is not uniform and so the reinforcing effect of the glass fiber is reduced.

It is known that glass fiber in the form of glass chopped strand results in a higher impact strength of a glass fiber reinforced cement sheet made therefrom than glass fibers existing in a form of monofilaments.

However it is also known that glass fiber uniformly well dispersed as monofilaments improves the bending strength of the glass fiber reinforced cement sheet relative to glass chopped strand.

With the foregoing in mind we endeavoured to find a suitable method of stirring fiber, cement and water without conglomeration of the glass fiber using glass chopped strand having a low number of filaments, and it was found unexpectedly that the joint use of asbestos fiber with glass fiber is advantageously effective to prevent the conglomeration of the glass fiber in the slurry. This fact was confirmed by the following experiment wherein slurry was made by stirring raw materials consisting of 1 part of glass monofilament of 4.5 μm diameter, 0—20 parts of asbestos and the residual parts of cement, with water of volumetrically 20 times amount of the raw material. It was found that when asbestos is used by an amount of more than 1.2 times of that of glass fiber the conglomeration phenomenon of the glass fiber does not appear.

As above-mentioned, when the conglomeration of the glass fiber does not occur the glass fiber opens uniformly within a short period during stirring. Thus simultaneous stirring of the raw material consisting of glass fiber, asbestos, cement and water results in a stirring period beyond that suitable for the glass fiber. It is therefore important to shorten the period of stirring thereof.

It is thus preferable to first stir the asbestos and the cement and subsequently to stir the resultant mix with the glass fibre. This sheet manufacturing process is very useful in the prevention of both conglomeration and breaking off or damaging of glass fibre. The desirable effects of shortening the stirring period of the glass fibre can be seen clearly from the following eg: it necessitates a 3 minute period of stirring 5000 Kg of water and 300 Kg of solids consisting of 15% by weight Chrysotile asbestos (JIS-A-5403) 1% by weight of glass fibre (10 mm length and 5 μm diameter) and cement to 100% to obtain a uniformly opened glass fibre. However, when asbestos, cement and water were stirred for 3 minutes and the glass fibre subsequently added and stirred for a further 30 seconds; there was obtained a sufficiently uniformly opened glass fibre.

According to the present invention there is provided a method for manufacturing a fibre reinforced cement article comprising the steps of:

a. mixing asbestos, cement and water with stirring to form a slurry in a tank;
b. admixing glass fibre with the resultant slurry of step (a.) with stirring in said slurry tank, and
c. forming the cement article using the product of step (b.).

According to the present method, in the step of the stirring, the prevention of the conglomeration of the glass fibre, even if it is chopped strand having small members of constructional monofilaments, can be easily achieved, and since the glass fibre opens uniformly within short period of time during stirring of the slurry, and the prevention of breaking and damaging of the glass fibre can be satisfactorily acquired owing to this shortening of the stirring period of time.

According to the present invention glass fiber is a principal reinforcing material and asbestos is an assistant one. Therefore asbestos material of lower than class 6 which is cheaper, can be used for this purpose.

According to the present invention the principal reinforcing material is glass fiber, and the manufactured sheet material can be used as architectural materials of which bending strength is usually required to be in range of 200—350 Kg/cm^2 and so the content of the glass fiber in the slurry should be in range of 0.2—4% by weight based on the raw material weight.

According to the present invention, as is above set forth, since addition of asbestos has a purpose to prevent generation of conglomeration of the glass fiber, asbestos is employed at an addition amount of more than 1.2 times of that of glass

fiber, i.e. more than 0.24—5% by weight based on the raw material weight. The asbestos contained in the slurry functionally behaves as a carrier relating to the glass fiber when the sheet is made on the mesh cylinder of a paper making machine, accordingly it is desirable to use asbestos in quantities such as to display its functional carrier effect. Thus the limitation of the amount of asbestos to a range of 5—20% by weight based on the raw material weight. If a suitable amount of polyacrylamide is added therein, the above described amount range of 5—20% by weight may be decreased.

In the present invention, in order to improve functional behaviour of the glass fiber reinforced cement sheet during sawing and nail driving, pulp may be admixed to the slurry. When forming the sheet on the mesh cylinder of a paper making machine, the pulp added behaves as a carrier, like asbestos when added as above-mentioned, to the glass fiber contained in the slurry. It is preferable to add pulp in an amount of less than 12% (preferably 10%) by weight, based on the raw material weight, since a greater amount of pulp addition would bring about a lowering of the bending strength of the sheet obtained.

According to the present invention, the chopped strand employed preferably has fiber length of less than 20 mm, and even if the strand is constructed with small number of monofilaments, the conglomeration of the glass fiber in the slurry treatment can be avoided with a help of asbestos. As is obvious through above description, length of the glass monofilament should be smaller than that of the glass strand and the former length is preferably less than 10 mm.

Further the glass chopped strand is itself a conglomeration of the glass fiber and so and increase in the number of glass fibers contained in the glass chopped strand would so bring about a non-uniformly opened state of the glass fiber in the final sheet such that enhancement of the impact strength of the sheet can not be expected. Consequently it is desirable to use the glass chopped strand containing less than 600 monofilaments.

According to the present invention it is desirable to adopt jointly glass monofilament and glass chopped strand for manufacturing of the sheet.

Since in the sheet obtained in accordance with the present invention more attention is paid to its bending strength than to its impact strength, it is more preferable to use glass monofilament than glass chopped strand in the sheet manufacturing mix, but from a health and safety point of view chopped glass fibre strand is preferable.

Thus glass chopped strand of which more that 50% is openable into monofilament form can be profitably fed into pulper to produce a slurry which combines both glass monofilament and glass chopped strand.

As a chopped strand of which more than 50% is openable into monofilament form, we use a chopped strand which is made by cutting glass roving with roving cutter, of which less than 50% is sized with a water insoluble sizing agent and of which residual part is sized with water soluble sizing agent. Of course it is possible to feed the glass chopped strand which is sized with water insoluble sizing agent and glass monofilament at a same time or separately Especially in the latter case it is desirable to feed the glass chopped strand first and after stirring thereof to some extent, to feed the glass monofilament secondarily, in order to prevent the damage of the glass monofilament.

According to the present invention, asbestos cement, water and if necessary pulp are stirred at first in a slurry tank or pulper, and glass fiber is added thereto and further stirring of slurry is continued and thus a final slurry is obtained. It is preferable that the stirring period of the slurry after feeding the glass fiber is as short as possible, e.g. 60 seconds, and preferably 20—40 seconds in order to prevent the damage of the glass fiber.

During the stirring especially after feeding glass fiber into the slurry, a suitable amount of a cationic or anionic surfactant may be added to the slurry in order to promote the opening of the fiber in the slurry.

Thus the obtained slurry is fed to a holding tank and is formed into thin sheet layer on a mesh cylinder. The resultant sheet layer is then transferred onto a felt belt which rotates in contact with the mesh cylinder and is then further transferred and wound onto a forming roll which rotates in contact with the belt. When the thickness of the sheet layer wound on the forming roll reaches to the designated thickness, the sheet is cut and peeled off and formed into a flat plane shape and then pressed. The purpose of the pressing is to remove water mechanically from the sheet layer, to give compactness to the sheet matrix, and to increase the bonding force of the glass fiber to the cement matrix. The compressing is conducted under a pressure of 40—80 Kg/cm^2.

After the pressing the sheet may be aged by allowing to stand outdoors or in water. After the aging the sheet is if necessary coated with paint. Of course alkali-resistant glass can be used as a raw material, but this glass may lead to alkali-corrosion, and upon steam aging of the sheet, the temperature of the steam must be controlled to less than 110°C, that is to say, autoclave aging has to be avoided.

In the present invention the cement material may be Portland cement mixed with silica of more than 50% by weight based on the total mixture weight. In such a mix autoclave aging is prohibited therefore upon mixing of silica and cement, both ingredients do not react to yield their reaction product of Tobermolite and so improvements of bonding strength of the sheet obtained therefrom can not be expected. Silica is cheaper than Portland cement. If the mixing ratio of Portland cement and silica equals to 1:1, an improvement in bending property of the sheet obtained can be seen and bending extent reaches twice of that when no silica is added, and the bending strength lowers by only 8%. Basing on the above described reasons the silica is suitable as a filler of the sheet. Compared to cement, the silica sand does not stain the felt, helping maintain the neatness of the manufacturing process equipment.

Silica can be substituted by calcium carbonate powder, tiny particle sized scraps produced from the sheet manufacturing process, rock or stone particles, gypsum, and if possible to buy economically pozzolan of active silica. Active silica so reacts with free lime that the generation of efflorescence phenomenon of the sheet can be advantageously prevented.

Examples of the present invention will be explained hereunder; they are included by way of illustration only.

Example 1

Raw materials of total weight 300 Kg were employed as follows:

Raw material	% by weight
asbestos (class 6)	15
regenerated pulp	0.8
cement (Portland cement stipulated in JIS-R-5210)	83.2
glass chopped strand:	
main ingredients	
% by weight	
SiO_2 60—70	
ZrO_2 12—16	
P_2O_5 1— 3	
glass chipped strand:	
300 monofilaments, diameter of 13μ; sized with water soluble size and openable to monofilament;	
fiber length 6 mm 0.5% by weight	
13 mm 0.5% by weight	
	100 (300 Kg)

The raw materials asbestos, pulp, and cement were mixed altogether with 5000 Kg water in a pulper (blade type stirrer; 700 r.p.m.; capacity 7 m^3) for 3 minutes. Glass fiber was fed thereinto and stirring was continued for 3 minutes to obtain a homogeneous slurry. The slurry obtained was fed to a holding tank, and then onto a 60 mesh paper making cylinder having a peripheral speed of 30 m/min, to obtain a sheet layer. The resultant sheet layer was transferred onto the felt belt and then further transferred and wound onto a making roll until thickness of the sheet layer reached a predetermined value of 6 mm. The sheet was then cut off and peeled from the roll. The water content of the sheet layer on the felt belt during the sheet making operation was 40—50%. This water content is a little too high, so a suction pump was disposed between the felt belt and the making roll to control this water content to a value of 20—30%.

Raw sheet peeled of from making roll was formed to a flat sheet shape and compressed at a pressure of 80 kg/cm^2 by a press until it was 4.5 mm thick. The sheet was then aged by allowing it to stand outdoors.

The aged sheet had the following bending strength.

Aging period (days)	4	7	30	180
bending strength (kg/cm^2)	320	340	350	350

Example 2

A composition was formed as follows:

Raw material	% by weight
asbestos (Chrysotile asbestos; JIS-A-5403)	15
cement (Portland cement; JIS-R-5210)	15
glass fiber (Monofilament: 1=13 mm; outer diameter=13 μm)	1
	100

The above raw materials were treated as in Example 1, i.e. slurry making—sheet making—compressing to 4.5 mm sheet thickness. The sheet obtained was aged by allowing it to stand outdoors for 3 days and then in water for 7 days.

Bending strength of the aged sheet was measured as follows:

Period of time elapsed in atmosphere after aging in water (days)	7	14	28	60	180
Bending strength (Kg/cm^2)	350	340	335	335	330

Example 3

A composition was formed as follows:

Raw material	% by weight
asbestos (Chrysotile asbestos; JIS-A-5403)	15
cement (Portland cement; JIS-R-5210)	84
glass fiber (monofilament; outer diameter =13 μm) 1=6 mm 0.5% 1=13 mm 0.5%	1
	100 (300 Kg)

The raw material was treated as in Example 2; i.e. slurry making—sheet making —compressing—aging.

Bending strength of the sheet aged in water was measured as follows:

Period of time elapsed in atmosphere after the aging in water (days)	14	28	60	180
Bending strength (kg/cm^2)	360	350	350	350

Example 4

A composition was formed as follows:

	% by weight
asbestos (Chrysotile asbestos; JIS-A-5403)	10
regenerated pulp	1
cement (Portland cement: 60% by weight silica powder: 26.5% by weight)	86.5
glass fiber (chopped strand: 300 monofilaments; diameter 13 m; sized with water insoluble size; 1=6 mm 1.25% by weight 1=13 mm 1.25% by weight	2.5
	100 (300 Kg)

The above raw material was treated as in Example 1 except that the period of stirring after glass fiber addition was conducted for 25 seconds, and the sheet layer was wound onto the making roll until the thickness reached to 4.0 mm.

Bending strength of the aged sheet obtained by allowing it to stand outdoors was measured as follows:

Aging period (days)	4	7	30	180
Bending strength (Kg/cm^2)	400	390	390	390

In each above described example there occurred no conglomeration of the glass fibers during sheet manufacture, and the sheet obtained showed bending strength of more than 300 Kg/cm². This, it is believed was due to the shortening of the stirring period after the glass fiber addition eg to within 30 seconds. Impact strength of the sheet obtained in above-mentioned examples, may be exemplified by that of the sheet of Example 2, measured 2 months after aging in water, which was 5.01 Charpie. The impact strength of the sheet obtained in accordance with the present invention is equal or superior to the value of Charpie 4.70 of conventional asbestos reinforced cement sheet obtained by using asbestos at 35% by weight.

The impact strength of the fiber reinforced cement sheet may be improved by adding an organic synthetic fiber to the mixture of asbestos, cement, and water, and continuing stirring, and then adding thereto glass fiber and further continuing stirring. Said organic synthetic fiber preferably has properties such as excellent tensile strength (eg more than 9 g/d) and a low elongation (such as 5—7%) so as not to result in a lowering of the bending strength of the glass fiber reinforced cement sheet manufactured. Said organic synthetic fiber may be polyvinyl alcohol fiber made of Kurare Co., Ltd. (Vinylon (Registered Trade Mark) fiber: No. VPM 1502). Such organic fibers are preferably of 25 d and 5—25 mm cut length. A fiber of more than 25 d is not only not easy to produce industrially but is also apt to result in a drop in reinforcing effects. Fibers of less than 15 denier having the disadvantage such as that resilience of a single filament is small, and bulkiness of the fiber is so large that its uniform opening in the slurry becomes difficult.

The length of the organic synthetic fiber is suitably within the range 5—25 mm. Where the length is more than 25 mm uniform opening of both organic synthetic fiber and other fibers is not feasible owing to the tangling phenomenon when fibers of more than 25 mm length are used. When the fibers are less than 5 mm, the bending strength of the glass fiber reinforced cement sheet obtained is liable to be reduced.

The addition of less than 1% by weight based on the total raw material weight of the organic fiber is desirable. It has a low specific gravity and is bulky; but at amounts less than 1% by weight fiber can be easily opened to a uniform dispersion in the slurry. The organic synthetic fiber can be fed into the pulper coincident with cement and asbestos; but it may be also feasible to utilize an already well mixed mixture of organic synthetic fiber and asbestos obtained by preliminary mixing.

An example of the present invention in which an organic synthetic fiber was employed is described hereunder by way of illustration.

Example 5

The following raw material composition was used;

	% by weight
organic synthetic fiber (polyvinyl fiber made of Kurare Co., Ltd.; "Vinylon"; tensile strength: 9—12 g/d; 15d)	0.8
asbestos (Chrysotile asbestos; JIS-A-5403)	8
regenerated pulp	2
cement (Portland cement; JIS-R-5210)	88.2
glass fiber (chopped strand; diameter 13 μm; 80% of the fiber is dispersible in water; 1=6 mm 0.5% by weight 1=13 mm 0.5% by weight	1
	100 (300 Kg)

The asbestos and organic synthetic fiber were fed into a mixer and admixed well, and the resultant product was fed to a pulper with pulp, cement and 5000 Kg of water and mixed well for 3 minutes with stirring and then the glass fiber was fed thereinto and stirring was continued for 30 seconds. The resultant slurry was fed to a holding tank and then formed into the sheet layer on a 60 mesh paper making cylinder the resultant sheet layer was then transferred and wound onto a forming roll until thickness of the sheet layer reached 4.0 mm. The sheet layer was then cut and peeled from the roll. At the water content of the sheet layer on the felt belt was as high as 40%, a suction pump was disposed in front of the roll so as to reduce said water content

to 25%. The sheet layer was then formed to a flat shape and compresser under a pressure of 80 kg/cm^2 and then subjected to aging outdoors.

The sheet obtained showed its mechanical properties as follows;

Aging period (days)	7	30	90	180
Bending strength (Kg/cm^2)	370	360	—	360
Charpie impact strength (Kg.cm/cm^2)	7.0	6.3	6.0	6.0

Example 6

The following 300 Kg of raw materials were used:

	% by weight
organic synthetic fiber (Polyvinylalcohol fiber "Vinylon" made of Kurare Co., Ltd., 20 d; tensile strength 10 g/d)	0.8
asbestos (Chrysotile asbestos; JIS-A-5403)	8
regenerated pulp	2
cement (Portland cement; JIS-R-5210)	88.2
glass fiber (monofilament: diameter 13 μm; 1=13 mm 0.5% by weight 1=6 mm 0.5% by weight	1
	100 (300 Kg)

The above described raw materials (total 300 Kg) were treated in the same manner as in Example 5 to make a sheet except that the thickness of the sheet layer was 6.0 mm and aging was conducted by allowing the formed sheet to stand outdoors for 3 days and further in water for 7 days.

The bending and impact strength of the sheet obtained was as follows:

Period of time elapsed in atmosphere after the aging in water (days)	7	14	20	60	180
Bending strength (Kg/cm^2)	350	350	340	340	340
Charpie impact strength (Kg.cm/cm^2)	—	—	—	6.05	—

Example 7

The following 300 Kg of raw materials were used:

	% by weight
Organic synthetic fiber (Polyvinyl alcohol fiber "Vinylon" made of Kurare Co., Ltd., 20d; tensile strength 10 g/d)	0.8
asbestos (Chrysotile asbestos JIS-A-5403)	8
regenerated pulp	2
cement (Portland cement; JIS-R-5210)	88.2
glass fiber (Monofilament: diameter 13 μm; 1=6 mm 0.5% by weight 1=13 mm 0.5% by weight	1
	100 (300 Kg)

The above described organic synthetic fiber, asbestos and regenerated pulp were mixed with 5000 Kg of water in a pulper for 3 minutes. Thereafter the glass fiber was added to the pulper and stirred for 3 minutes, and the resultant slurry was treated in the same manner as in Example 5 to obtain the finished sheet except that the wound up thickness of the sheet layer on the forming roll was 6.0 mm, and aging of the sheet was conducted in the same manner as of Example 6.

Measured result was as follows:

Period of time elapsed in atmosphere after the aging in water (days)	7	14	28	60	180
Bending strength (Kg/cm^2)	320	320	300	300	300
Charpie impact strength (Kg.cm/cm^2)	—	—	—	6.0	—

The results of the above described measurements show that the Charpie impact strength of the glass fiber reinforced cement sheets obtained in Example 5, Example 6, and Example 7 were advantageously improved compared to those obtained in Example 3 and Example 4 in which organic synthetic fiber had not been used. The above fact means that addition of the organic synthetic fiber to the raw materials contributes to the impact strength of the glass fiber reinforced cement sheet obtained.

In Examples 1—7 the sheet obtained shows a bending strength of more than 300 kg/cm². Bending strengths in range of 200—300 Kg can be obtained in sheets produced with less glass fiber used in manufacturing process. Satisfactory bending properties in such sheets are obtained by adding organic synthetic fiber in the slurry preparation step. The following example shows a fiber reinforced cement sheet having a bending strength of 200—300 Kg cm².

Example 8

The following 300 Kg of raw materials were used:

	% by weight
Organic synthetic fiber (polyvinyl alcohol fiber "vinylon" Kurare Co., Ltd. made 15d; tensile strength 12 g/d)	0.5
asbestos (Chrysotile asbestos; JIS-A-5403)	7.0
regenerated pulp	5.0
cement (Portland cement; JIS-R-5210)	87.0
glass fiber (glass chopped strand; 300 monofilaments; diameter 13 μm; l=13 mm; 80% of the filaments is able to open in water)	0.5
	100 (300 Kg)

The asbestos and organic synthetic fiber described above were mixed well in a mixer and the resultant mixture and the raw material pulp, cement and 5000 Kg of water were mixed together with stirring for 3 minutes in the pulper, glass fiber was then fed thereinto and stirring in the pulper was continued for 30 seconds to obtain a desired slurry. The slurry obtained was supplied to a holding tank and formed into the sheet layer on a 60 mesh paper making cylinder; the water content of the layer being controlled to 25% by a suction pump. The so-formed sheet was then transferred and wound onto the forming roll until the thickness of the sheet layer reached to 5.5 mm and thereafter the sheet layer was cut and peeled off from the forming roll, the raw sheet layer was then formed into a planar sheet and compressed under a pressure of 80 Kg/cm², and aged outdoors;

The sheet obtained had the following physical properties;

Aging period (days)	7	14	21	30	90	180
Bending strength (Kg/cm²)	256.3	262.0	249.6	215.1	—	—
Charpie impact strength (Kg.cm/cm²)	—	—	6.24	—	6.0	6.0

The bending degree of the sheet was measured as follows: (Span space: 400 mm; Width of test piece: 400 mm)

Aging period of time (day)	7	14	21	30
Bending (m. m)	17.9	17.4	17.0	18.9

As the sheet obtained in Example 8 has excellent bending properties it can advantageously be used as, for example, a ceiling material or wall cladding of high building. Further nails can be driven through the sheet with greater facility than with conventional asbestos cement sheets (asbestos: 5% by weight; pulp: 6% by weight; cement: 40% by weight; silica sand 40% by weight; aged in autoclave). According to the present invention, as can be seen from Example 8, manufacturing of an architectural board which has bending strength of 200—300 Kg/cm² and excellent bending and nail driving properties is practicable.

In summary therefore a sheet of the invention which has bending strength of 200—300 Kg/cm² and excellent bending and nail driving properties requires the usage of organic synthetic fiber and pulp. Thus a desired mix is 5—10% by weight of asbestos, 2—7% by weight of pulp, and sum total amount of asbestos and pulp being more than 10% by weight, 0.5—0.7% by weight of organic synthetic fiber which

has tensile strength of more than 9 g/d and elongation of 5—7%, 0.3—0.5% by weight of glass fiber of which more than 50% is openable to monofilament in water, the sum total of organic synthetic fiber and glass fiber being 0.9—1.2% by weight based on the total weight, and the residual parts being cement.

As above described, according to the method of the present invention, equipment conventionally used for asbestos cement sheet making can be used for manufacturing the fiber reinforced cement sheet of which reinforcing material is mainly glass fiber.

Thus the method of the invention is industrially useful in that this method can substitute for the conventional method for preparation of asbestos cement sheet utilizing a paper making method.

WHAT WE CLAIM IS:

1. A method for manufacturing a fiber reinforced cement article comprising the steps of:—

a. mixing asbestos, cement and water with stirring to form a slurry in a slurry tank,

b. admixing glass fiber with the resultant slurry of step (a.) with stirring in said slurry tank, and

c. forming the cement article using the product of step (b.).

2. A method according to claim 1 wherein the asbestos is in the form of fibres.

3. A method according to either of claims 1 or 2 wherein pulp is also admixed into the slurry of step (a.).

4. A method according to any preceding claim wherein the asbestos constitutes 5 to 20% by weight of total solids.

5. A method according to claim 4 wherein pulp constitutes 0—12% by weight of the total solids and wherein the total amount of asbestos and pulp exceeds 10% by weight.

6. A method according to any of the preceding claims wherein the glass fibre constitutes 0.2—4% by weight of total solids.

7. A method according to any preceding claim wherein an organic synthetic fibre is added to the slurry of step (a.).

8. A method according to claim 7 wherein the organic synthetic fibre constitutes less than 1% by weight of the total solids, has a tensile strength of more than 9 g/d and an elongation of 5—7%.

9. A method according to claim 7 or 8 wherein the asbestos and the organic synthetic fibre are admixed prior to their addition to the slurry tank of step (a.).

10. A method according to any preceding claim wherein the glass fibre is chopped glass strand and glass mono-filament.

11. A method according to claim 10 where in the chopped glass strand is derived from a strand of 600 monofilaments or less.

12. A method according to either of claims 10 or 11 wherein at least 50% by weight of the chopped glass strand is openable into monofilaments in water.

13. A method according to any preceding claim wherein the article is in sheet form.

14. A method for the manufacture of fibre reinforced cement articles substantially as hereinbefore set forth with reference to and as illustrated in the foregoing Examples 1—8.

15. A fibre reinforced cement article manufactured according to the method of any one of the foregoing claims.

16. A composition for forming a fibre reinforced cement article comprising 5—20% by weight of asbestos, 0—12% by weight of pulp, the total amount of asbestos and pulp exceeding 10% by weight, 0.2 to 4% by weight of glass fibre and cement to 100% by weight.

17. A composition according to claim 16 including less than 1% by weight of an organic synthetic fibre having a tensile strength of more than 9 g/d and an elongation between 5 and 7%.

18. A composition according to either of claims 16 or 17 wherein the glass fibre is chopped glass strand and a glass monofilament, said chopped glass strand being derived from a strand of 600 monofilaments or less.

19. A composition substantially as hereinbefore set forth with reference to and as illustrated in the foregoing Examples 1—8.

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